R325 Single Axis Controller / Driver

User Manual
And Commands Guide

Version 1.02

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Thank you for purchasing the R325 Single-Axis Controller/Driver. This product is warranted to be free of manufacturing defects for one (1) year from the date of purchase.

PLEASE READ BEFORE USING

Before you start, you must have a suitable step motor, a DC power supply suitable for the motor and a current resistor. The power supply voltage must be between 4 times and 20 times the motor's rated voltage.

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1. FEATURES

- Single Axis Driver for Bipolar step motors
- Operates from +12 to 48 VDC
- Phase currents from 0.25 to 3.0 Amp Peak **(2.7 Amp and above REQUIRES an additional heatsink, make sure the temperature of the bracket does not exceed 45° C)**
- Hold current reduction capability with adjustable current and timeout settings
- Selectable Step Resolution from Full Step to 256x Microstepping
- Has three optically isolated control inputs and one optically isolated control output
- Software configurable by the temporary use of a plug-in USB module and text commands from HyperTerminal or any similar terminal emulation software.
- Configuration Parameters stored in non-volatile memory.
- Multiple module control through software assigned single character addresses
- Built-in control routines for trapezoidal position and velocity moves
- Absolute position can be tracked and reported in step resolution increments

Dip switches and a RS485 interface are built-in to the R325 Controller. A USB connection can be used by using the USB485 Converter Card (sold separately).

Optically Isolated Inputs and Output

The default usage of the three optically isolated inputs is Step, Direction and Disable. The assignment of Disable is fixed; however the other two inputs can be assigned to other functions as part of software customization. For example one can be used for Go-Resume and the other for Stop-Quit.

The normal usage of the single optically isolated output is to indicate motion by sending a pulse every time a step is made.

2. ELECTRICAL SPECIFICATIONS

Supply Voltage: +12 to 48 VDC
Phase Current: 0.25 to 3.0 Amps Peak **(2.7 Amp and above REQUIRES an additional heatsink, make sure the temperature of the bracket does not exceed 45° C)**

I/O Specifications
- 3x Optically Isolated Inputs (1 fixed)
- 1x Optically Isolated Output

3. OPERATING SPECIFICATIONS

Maximum Step Frequency: 2.5 MHz
Operating Temperature:
- Automatic Motor Holding Current reduction available from 0.2 to 2.5 Amps

Logic Timing

Minimum Step Pulse Width	200 nanoseconds
Minimum Step Low Time	200 nanoseconds
Maximum Power-Down Recovery Time	20 milliseconds

4. COMMUNICATION SPECIFICATIONS

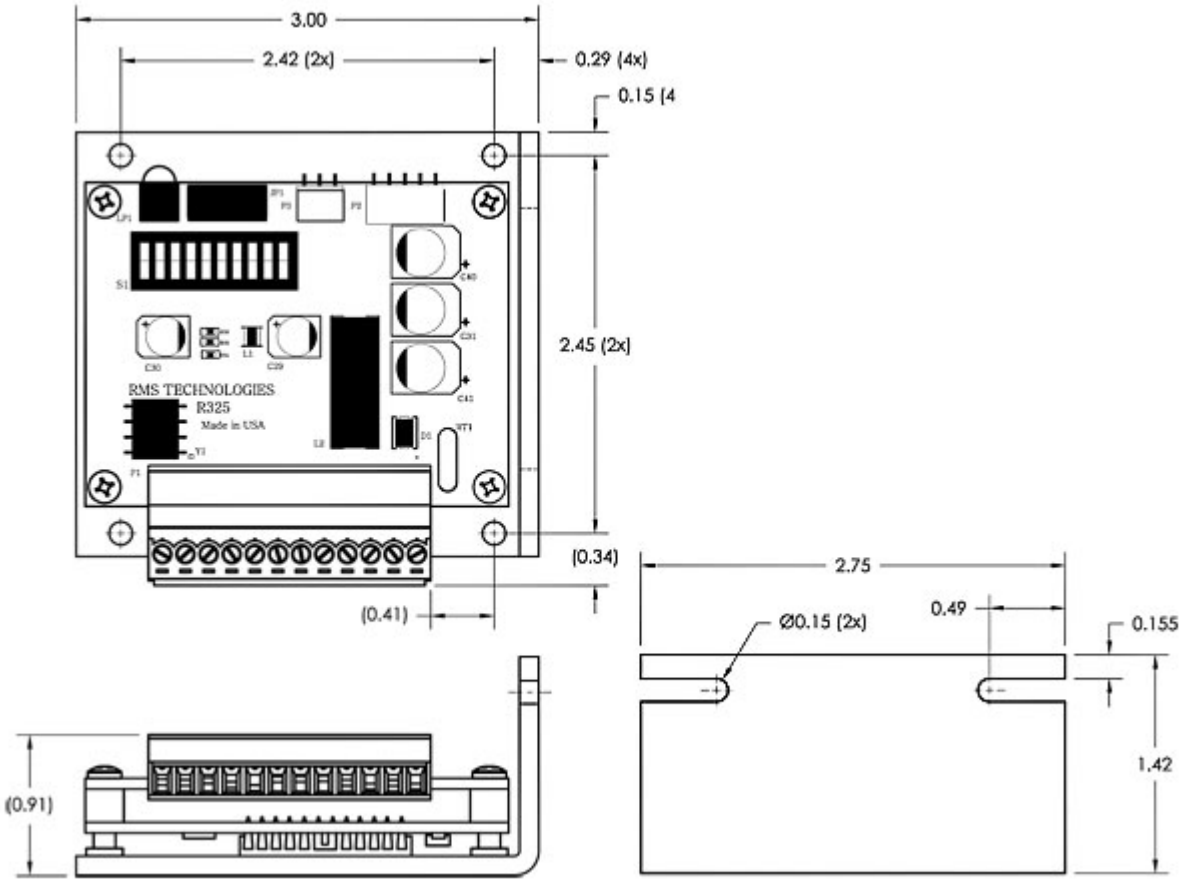
Address bytes in the RS485 commands allow multiple units (32 units max) to be controlled from a single host port.

Interface Type	RS485
Baud Rate	57600 bits per second (bps)
# Bits per character	8 data bits
Parity	None
Stop Bit	2
Flow Control	None

5. MECHANICAL SPECIFICATIONS

Size: 3.00” x 2.94” x 1.42”
Weight: 4.8 oz
Mounting: Four #6-32 screws, 2.42” x 2.45”
Plate: Aluminum, Hard Anodized

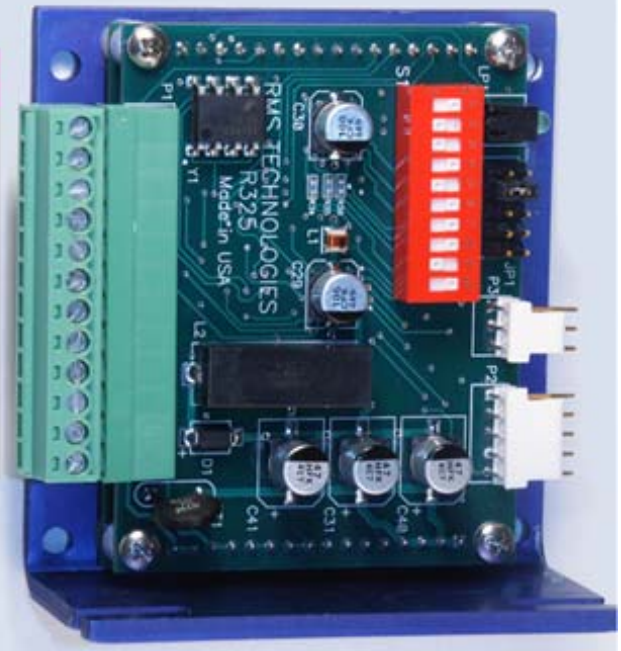
Dimensions



6. PIN ASSIGNMENTS

A 12 pin pluggable terminal strip connector JP1 provides power and the step and direction control functions for the module. All of these signals are optically isolated. Open-collector drives are required to provide pulses for Step, levels for Direction, and Disable. The common +ve supply can be +ve 5 to 30 VDC with respect to the signal input; however if the supply is greater than 5 VDC then a resistor must be inserted in series with each signal line to limit the current to 10 mA.

P1 Configuration	
Pin No	**Function**
1	Common +ve External
2	Step (in)
3	Direction (in)
4	+5 VDC Internal
5	Disable (in)
6	Motor A+ (out)
7	Motor A- (out)
8	Motor B+ (out)
9	Motor B- (out)
10	Fault (out)
11	Power Ground
12	Power Positive



A separate three pin connector P3 is provided for the RS485 bus interface

P3 Configuration	
Pin No	**Function**
1	A Input (+ve)
2	Ground
3	B Input (-ve)

7. CONNECTION SPECIFICATIONS

To begin using the R325, first determine how you will operate the unit: Driver Only, or Simple Controller/Driver. When using the Driver Only portion of the R325, use the dip switches for step resolution and current settings. When using the Controller/Driver, setup must be made with an RS485 connection and communication can take place using Windows HyperTerminal.

Using the R325 as a Driver Unit Only

If using the R325 as a Driver only, **be sure to connect the power supply last.**

Pin1: Connect Pin 1 to Pin 4 to use the internal +5VDC. By using the internal +5VDC the I/O's will no longer be optically isolated. If optical isolation is still desired, use a separate +5VDC supply and connect the POSITIVE end of the supply to Pin 1. The NEGATIVE end will connect with the NEGATIVE end of your pulse generator.

Pin 2: Use a pulse generator or function generator to receive pulses into the R325. Connect the POSTIVE end of the pulse generator to Pin 2. The NEGATIVE end will be connected to the NEGATIVE end of the +5VDC supply if using a separate power source. If using the internal +5VDC supply, connect the NEGATIVE end of the pulse generator to Power GROUND.

Pin 3: To switch the direction of motor rotation, connect Pin 3 with Pin 11, Power Ground. An open or closed connection to Power Ground will change the direction.

Pin 4: This is the internal +5VDC. Use this for testing purposes or if optical isolation of the I/O's is not desired.

Pin 5: To enable and disable the drive, connect Pin 5 with Pin 11, Power Ground. An open or closed connection to Power Ground will enable and disable the drive, respectively.

Pin 6: Phase A Motor Connection

Pin 7: Phase $\overline{A}$ Motor Connection

Pin 8: Phase B Motor Connection

Pin 9: Phase $\overline{B}$ Motor Connection

Pin 10: The Fault Output is not available for this version of the R325. Future versions such as the R325I or R325IE will accommodate for the Fault Output

Pin 11: Connect the NEGATIVE of the Power Supply to this terminal.

Pin 12: Connect the POSITIVE of the Power Supply to this terminal. (+12 to 48VDC)

Connecting the Power

The R325 requires a supply voltage between 12-48 VDC. First, connect the positive end of the power supply to positive terminal (Pin 12), and then connect the negative of the power supply to the Ground (Pin 11) on the R325.

WARNING! Be careful not to reverse the polarity from the power supply to the driver. Reversing the connection will destroy your driver and void the warranty.

HyperTerminal Configuration

If using the USB or RS485 plug-in modules, you will need to configure HyperTerminal to properly communicate with the R325.

Please follow these steps to properly set up HyperTerminal:

1. Open a terminal from your PC by following these steps: Start Menu → Programs → Accessories → Communications → HyperTerminal
2. Assign a name for your New Connection, "Click Ok"
3. Under "Connect using", select the COM connection that corresponds to your PC serial port (i.e. COM 1, COM 2, etc.) then click "OK"
4. Set your Port Settings to:
   Bits per second: 57600
   Data bits: 8
   Parity: None
   Stop bits: 2
   Flow control: None
   Click "OK"
5. Turn on local echo by going to: File → Properties → Settings tab → ASCII Setup: Check the boxes for "Send line ends with line feeds" and "Echo Typed Characters Locally." These options will be useful when typing commands in HyperTerminal. Click 'OK", Click "OK"
6. HyperTerminal is ready to send commands

The line turnaround from transmit to receive must be less than one character interval (191 µS).

The command syntax is as follows:

#<Board Address><Command><Value><cr><lf>

The reply syntax is:

**<Board Address><Command> <Value><cr><lf>*

Note: Not all commands will return a value.

Example
Setting the Run Current (RI) to 1500mA (1.5A)

```
#ARI1500   //Sent Command
*ARI1500   //Received Reply
```

Setting the Current

There are two current settings on the R325.

1. Run Current (RI) – The peak current that the motor will be run at while in motion. **NOTE: 2.7 Amp and above REQUIRES an additional heatsink, make sure the temperature of the bracket does not exceed 45° C**
2. Hold Current (HI) – The current that the motor will receive when idle.

*The default board address of 'A' is used in all examples, please see "MA" command for more detail on addresses.

Examples:

To set Run Current to 2000mA (2.0A):

```
#ARI2000
```

To set Hold Current to 300mA (0.3A):

```
#AHI300
```

Setting Step Resolution

The R325 is capable of full stepping or 2, 4, 8, 16,32, 64, 128, and 256 microstepping.

Example:

To set Step Resolution to 4x microstepping:

```
#ASR4
```

Saving the Configuration

In order to have these settings retained upon a power cycle, the data must be saved. The command to store these settings is "SD" (Save Data).

Example:

To save settings:

```
#ASD
```

Connecting the Motor

WARNING! Make sure the power is OFF when connecting or disconnecting motors from the R325. Damage will occur if the power is being supplied.

Please refer to your motor documentation for wiring color code.

Connect the corresponding Phase from the motor to the proper pin on the R325.

Using the R325

If using the R325 in Step/Direction mode, please proceed to Section 8 – Basic Step and Direction Operation.

If using the R325 as a simple controller, please see the Command Tables in Section 9 and more detailed descriptions of the Commands in Section 10.

Using the Plug-Ins to Configure the R325

R325 DIP Switch Settings

When using the DIP Switch module, the R325 comes shipped with a jumper on Pins 7 & 8 on JP2 which configures the R325 for DIP Switch operation.

Run Current				
Function	**SW1**	**SW2**	**SW3**	**SW4**
0.3A	ON	ON	ON	ON
0.4A	OFF	ON	ON	ON
0.5A	ON	OFF	ON	ON
0.6A	OFF	OFF	ON	ON
0.8A	ON	ON	OFF	ON
1.0A	OFF	ON	OFF	ON
1.2A	ON	OFF	OFF	ON
1.4A	OFF	OFF	OFF	ON
1.6A	ON	ON	ON	OFF
1.8A	OFF	ON	ON	OFF
2.0A	ON	OFF	ON	OFF
2.2A	OFF	OFF	ON	OFF
2.4A	ON	ON	OFF	OFF
2.6A	OFF	ON	OFF	OFF
2.8A	ON	OFF	OFF	OFF
3.0A	OFF	OFF	OFF	OFF

WARNING: 2.7 Amp and above REQUIRES an additional heatsink, make sure the temperature of the bracket does not exceed 45° C

Hold Current (Percent of Run Current)		
Function	**SW5**	**SW6**
0%	ON	ON
33%	OFF	ON
66%	ON	OFF
100%	OFF	OFF

Step Resolution				
Function	**SW7**	**SW8**	**SW9**	**SW10**
Full Step*	OFF	OFF	OFF	OFF
2X	ON	OFF	OFF	OFF
4X	ON	ON	OFF	OFF
8X	ON	OFF	ON	OFF
16X	ON	ON	ON	OFF
32X	ON	OFF	OFF	ON
64X	ON	ON	OFF	ON
128X	ON	OFF	ON	ON
256X	ON	ON	ON	ON

*The power must be turned OFF when switching in and out of Full Step mode.

Notes:

1. An 'ON' switch generates a zero in the firmware.
2. All switches must be set to 'OFF' to set the Step Resolution by firmware. This is in addition to installing the jumper on JP1 pins 9 and 10
3. Installing a jumper on JP1 pins 7 and 8 runs the factory test routine
4. Full Step is not implemented on the first prototypes

8. BASIC STEP AND DIRECTION OPERATION

The four control signals *Step, Direction, Disable,* and *Fault Out* are optically isolated, with a common positive connection (usually 5 VDC).

The common positive connection (Pin 1) is typically 5 VDC. Each of the inputs is set to TRUE by supplying a signal level 5V below the common positive connection powering the optical isolators. The input is set FALSE by putting the signal within 0.5 VDC below the common positive value.

Example: If 5 VDC is supplied to Pin 1 (common positive connection), TRUE is 0V, and FALSE is any value between 4.5 VDC to 5 VDC.

For test purposes, and some applications where input isolation is not required, the internal 5 VDC supply at Pin 4 of the I/O connector can be used as the common positive connection, by linking pins 1 and 4 on the connector.

If this is done then each input is set TRUE by bringing the voltage level at the input equal to, or more negative than the Power Supply negative connection at Pin 11.

With this arrangement *Direction, Disable,* and *Fault Out* control can be effected by simple switch closure between the input and the power negative connection at Pin 11.

If the *Step* input is obtained from a Function Generator, then careful adjustment of the Offset control is needed to ensure that the negative level of the input signal is equal to, or more negative than, the power negative connection at Pin 11.

The minimum duration of the active (negative) *Step* input signal level is 400 nanoseconds and also this is the minimum for the inactive (positive) level. This limits the maximum usable step rate to 2.5 Mhz.

The optimum operating arrangement (minimum power usage) is for a constant width negative going pulse of 400 nanoseconds with the pulse interval varying with pulse rate.

For test purposes, setting the Function Generator duty cycle to 50%, and just varying frequency is satisfactory.

9. COMMAND TABLES

Basic Configuration Commands

Function	Query / New	Code	Value	Minimum	Maximum	Default
Load Defaults	N	LD	None	-	-	-
Save Data	N	SD	None	-	-	-
Module Address	Q/N	MA	Numeric	65 (A)	90 (Z)	65 (A)

Axis Configuration Commands

Function	Query / New	Code	Value	Minimum	Maximum	Default
Acceleration	Q/N	AC	Numeric	1	256	50
Current Decay	Q/N	CD	Numeric	0	3	TBD
Hold Current	Q/N	HI	Numeric	0	3000	300
Hold Timeout	Q/N	HT	Numeric	100	5000	5000
Min. Velocity	Q/N	MV	Numeric	250	50,000	250
Run Current	Q/N	RI	Binary	200	3000	1000
Read Switches	Q	RS	Numeric	0	15	-
Step Resolution	Q/N	SR	Numeric	1	256	16
Start Velocity	Q/N	SV	Numeric	250	50,000	1,000
Velocity Limit	Q/N	VL	Numeric	250	50,000	15,000
Zero Position	N	ZP	None	-	-	-

General Operation Commands

Function	Query / New	Code	Value	Minimum	Maximum	Default
Absolute Position	N	AP	Numeric	-2147483646	2147483647	-
Current Position	Q/N	CP	Numeric	-2147483646	2147483647	-
Current Velocity	Q	CV	Numeric	0	50,000	-
Firmware Rev.	Q	FR	Numeric	-	-	-
Home Axis	N	HA	Numeric	0	1	-
Move Status	Q	MS	Numeric	0	1	-
Position Move	N	PM	Numeric	-2000000000	2000000000	-
Step Back	N	SB	None	-	-	-
Step Forward	N	SF	None	-	-	-
Stop Motion	N	SM	None	-	-	-
Velocity Move *	Q	VM	Numeric	-50,000	50,000	-

* Velocity Moves in the range –249 to 249 are not legal except zero

10. COMMANDS (Page per Command Listing)

Command Format is: #<Address><Command><value><CR><LF>
Response Format is: *<Address><Command><value><CR><LF>

Acceleration<value>

Initial Acceleration (1 to 255 steps/Sec ^2)

Command or Query.

Used to shape the acceleration and deceleration ramps of position moves, and the rate of velocity change for velocity moves.

Does not affect any of the basic step and direction move operations

Command Example

#AAC10000<cr><lf> Sets acceleration to 100 PPS^2.

Default value is 50

Absolute Position<value>

Absolute Position +/–2,147,483,646

Command Only

Used to make an absolute position move (in step resolution units).

Command Example

#AAP1000<cr><lf> Moves to absolute position of 1000.

Current Position<value>

Current Position +/–2,147,483,646

Command or Query.

Returns the absolute position of the axis if no value is passed. Valid after power cycles if a Save Data Command is issued before power down. Can be used to set current position value.

The units are steps at the current step resolution. (Value becomes invalid with step resolution changes.)

The absolute position scale is set to zero by the Zero Position command (ZP) or the execution of a Home Axis (HA) command.

Command Example

#ACP<cr><lf> Returns the Current Position of the Motor

#ACP1000<cr><lf> Sets the Current Position to be 1000

Current Velocity

Query Only +/- 50,000

Only valid when a Position Move (PM) or Velocity Move (VM) is in progress. Otherwise returns zero.

Command Example

#ACV<cr><lf>

Firmware Revision

Query Only

Returns 3 digit part code followed by 3 digit firmware revision value.

Command Example

#AFR<cr><lf>

Reply

*AFR325100 //R325 firmware revision 1.00

Home Axis<value>

Command Only, (0 = Forward, 1 = Reverse)

Causes the motor to move at the preset Start Velocity (SV) in the direction set by the command value. Motion stops when the index input of the encoder goes TRUE then stops and sets absolute position to zero. Motion can also stop by the entry of a Stop Motion (SM) command.

Forward is defined as the direction the motor turns when the 'Direction' input (JP1-3) is set TRUE, or there is no connection to this input.

Command Example

#AHA1<cr><lf> Motor turns in the Reverse direction.

Hold Current<value>

Command or Query 0 to 3000

Reads or sets the motor Holding Current in 100 milliamps increments. The value does not round.

Command Example

#AHI300<cr><lf> Sets the Hold Current to 300mA (0.3 Amp).

Default value is 300

Hold Timeout<value>

Command or Query 100 to 5000

Reads or sets the time interval in milliseconds after any motor movement, before the motor current is changed from Run Current to Hold Current

Command Example

#AHT100<cr><lf> Sets the Hold Timeout to 100 mS.

Default value is 5000

Load Defaults

Command Only

Loads all of the unit Default parameter values. A save Data (SD) command must be issued to have these values retained during a power cycle.

Command Example

#ALD<cr><lf> Loads all default values.

Default values are:

Module Address	65 (A)
Acceleration	50
Absolute Position	0
Current Decay	TBD
Hold Current	300 (0.3A)
Hold Timeout	5000
Minimum Velocity	250
Run Current	1000 (1.0A)
Step Resolution	16
Start Velocity	1000
Velocity Limit	15000

My Address<value>

Command or Query 65 to 90.

Reads or sets the unit address. The value read or entered is the decimal value of the ASCII character designated as the unit address. (65 = 'A' and 90 = 'Z')

The change to a new address is immediate, in that the command response will use the new address

Command Example

#AMA88<cr><lf> Sets the unit address to 88 ('X').

Default value is 65

Address	Value
A	65
B	66
C	67
D	68
E	69
F	70
G	71
H	72
I	73
J	74
K	75
L	76
M	77
N	78
O	79
P	80
Q	81
R	82
S	83
T	84
U	85
V	86
W	87
X	88
Y	89
Z	90

Move Status

Query Only.

Reads Motion Status. Returns 0 for No Motion, 1 for Position Move, and 2 for Velocity Move.

Command Example

#AMS<cr><lf> Queries the current status

Minimum Velocity<value>

Command or Query 250 to 50,000

Reads or sets the minimum velocity for both Position and Velocity command moves

The units are steps (at the current Step Resolution) per second

Command Example

#AMV500<cr><lf> Sets Minimum Velocity to 500 SPS

Default value is 250

Percent Fast Decay<value>

Command or Query 0, 1, or 2.

Allows the Damping Mode of the driver IC to be set.

0 = Fast Decay
1 = Mixed Mode 15%
2 = Mixed Mode 48%

The optimum setting will vary with motor inductance and step rate; however the default 'Mixed Mode' setting will work well with almost all motors.

Command Example

#ACD1<cr><lf> Sets Mixed Mode Damping to 15%.

Default value is 2

Position Move<value>

Command Only +/-2,000,000,000

Causes a 'Relative Motion' Position Move, using an approximately trapezoidal profile. The initial velocity is defined by 'Start Velocity' (SV), the profile ramp is defined by 'Acceleration' (AC), and the 'Constant Velocity' step rate by 'Velocity Limit' (VL). 'Minimum Velocity' (MV) is used to ensure that the deceleration ramp does not set velocity to zero before the target position is reached.

It should be remembered that, while the 'Position Move' value defines the number of steps to be made from the current position, the value returned by 'Current Position' (CP) both before and after a 'Position Move' are on an 'Absolute' step count scale.

CP readings can be used to determine PM values required to reach any given position on the 'Absolute' step count scale.

Command Example

#APM1000<cr><lf> Makes a 1,000 step move from the Current Position.

Note: This command does not return a value.

Run Current<value>

Command or Query 200 to 3000

Sets the motor Phase Current for any form of motion in milliamps.
200 = 200mA (0.2 Amp)
2500 = 2500mA (2.5 Amp)

The last two numbers of the value are not read.
250 = 200mA
2499 = 2400mA

The set 'Run Current' is maintained for a time set by 'Hold Timeout' (HT) before dropping to the current set by 'Hold Current' (HI)

Command Example

#ARI1000<cr><lf> Sets the run current to 1000mA (1.0 Amp).

Default value is 1000

NOTE: 2.7 Amp and above REQUIRES an additional heatsink, make sure the temperature of the bracket does not exceed 45° C

Read Switches

Query Only

Reads the TRUE (1) or FALSE (0) state of the three optically coupled inputs, combined into a single three-bit value. This command is used to check the correct operation of this interface.

The value order of the inputs is 'Direction', 'Disable', and 'Step'; in descending order.

'Direction' has the value 4 (100)
'Disable' has the value 2 (010)
'Step' has the value 1 (001)

Command Example

#ARS<cr><lf> Reads the switch inputs.

Step Back

Command Only

Makes a single step move at the current step resolution

Forward is defined as the direction the motor moves with the ‘Direction’ input in the FALSE state, or with no connection. Backwards is thus the direction the motor moves when the ‘Direction’ input is in the energized or TRUE state.

Command Example

#ASB<cr><lf> Moves one step back.

Save Data

Command Only

This command causes a set of parameter values to be written to non-volatile memory. On power up the last set of values written are set to be the parameter initial values.

The parameters whose values are thus saved are:

My Address
Absolute Position
Velocity Limit
Minimum Velocity
Start Velocity
Acceleration
Hold Timeout
Step Resolution
Run Current
Hold Current
Percent Fast Decay

Command Example

#ASD<cr><lf> Saves Data.

Step Forward

Command Only

Makes a single step move at the current step resolution

Forward is defined as the direction the motor moves with the ‘Direction’ input in the FALSE state, or with no connection. Backwards is thus the direction the motor moves when the ‘Direction’ input is in the energized or TRUE state.

Command Example

#ASF<cr><lf> Moves one step forward.

Stop Motion

Command Only

This command can be used to affect an end to any Position Move or Velocity Move in progress. It has no effect on motion produced by the Step and Direction inputs.

Command Example

#ASM<cr><lf> Stops any Position or Velocity move in progress.

Step Resolution<value>

Command or Query 1, 2, 4, 8, 16,32, 64, 128, or 256

Reads or sets the current step resolution

Allowed values are:

256 for 256x
128 for 128x
64 for 64x
32 for 32x
16 for 16x
8 for 8x
4 for 4x
2 for 2x
1 for 1x

Command Example

#ASR4<cr><lf> Sets the step resolution to 4x.

Default value is 16

Start Velocity<value>

Command or Query 250 to 50,000

Reads or sets the velocity used for the first step in a position move in steps/sec. Value based on motor performance.

Command Example

#ASV500<cr><lf> Sets Start Velocity to 500 PPS.

Default value is 1,000

Test Inputs

Query only

Step, Direction, and Disable.

Returns a value in decimal form.

The value order of the inputs is ‘Direction’, ‘Disable’, and ‘Step’; in descending order.

‘Direction’ has the value 4 (100)
‘Disable’ has the value 2 (010)
‘Step’ has the value 1 (001)

Command Example

#ATI<cr><lf> Reads the switch inputs.

Reply

*ATI3 // 3 = ‘011’

Velocity Limit<value>

Command or Query 250 to 50,000

Reads or sets the velocity used for Velocity Moves and the constant velocity portion of a Position Move.

Command Example

#AVL5000<cr><lf> Sets the velocity limit to 5000 steps/sec.

Default value is 15,000

Velocity Move<value>

Command Only (250 to 50,000, -250 to -50,000, or 0)

The sign of the value determines the direction (positive for forward, and negative for backward) in which the velocity move is made. The value sets the step rate in steps per second at the current step resolution. Velocity cannot exceed Velocity Limit

The move begins at the set 'Minimum Velocity' (MV), with the speed ramping to the command velocity at the rate set by 'Acceleration' (AC).

Changes to new velocity values from new VM commands, will also occur at the rate set by 'Acceleration' (AC).

Command Example

#AVM1000<cr><lf> Starts a velocity move of 1000 steps per second.

Note: No value is returned. Zero velocity makes an abrupt stop

Zero Position

Command Only

Sets the current value of the Absolute Position scale to zero

Command Example

#AZP<cr><lf> Sets Absolute Position to zero.

11. RS485 Communication

1. The Interface

The EIA specification RS485 defines an integrated circuit that is to be used to connect up to 32 nodes to a two-wire party line bus that does not exceed 4,000 ft. in length, and for use with data rates up to 10M Baud.

The two-wire bus must be terminated at one-end for short wire runs and at both ends if the runs exceed 20 ft. One of the two wires must be biased positive with respect to the other by approximately 700 millivolts.

A single 5VDC supply can be used to power the interface IC, and this same supply can be used to satisfy the bias and termination requirements. A 681 ohm 1% resistor is connected between the +5VDC supply and the positive line. A second 681 ohm 1% resistor is connected between ground and the negative line, and a 220 ohm 1% resistor is connected across the two lines. The transceiver A terminal is connected to the negative line and the B terminals to the positive line.

For wire runs over 20 ft, twisted pair cable with a characteristic impedance of approximately 100 to 200 ohms, and the far end of the run should be terminated by a 150 ohm resistor across the line pair. For runs under 20ft almost any wire can be used.

2. The Protocol

One node on the bus is designated 'Master' and all other nodes on the bus 'Slaves'. The Master only initiates communication, and does so by sending a message that includes the address of a specific Slave. All Slaves read the message, but only the addressed Slave replies.

The outgoing message from the Master is 'framed' by always starting the message with the '#' character (0x23) and ending with the linefeed character (0x0A). The reply from the Slave is framed by always starting with the '*' character (0x2A) and ending with the linefeed character (0x0A).

The Slave address is the first character after the '#' in the outgoing message, and the first character after the '*' in the reply. For ease of use RMS Technologies restricts the range of address characters to the range of capital letters 'A' to 'Z', with 'A' being the default.

Again for ease of use RMS Technologies restricts the other characters in the message to ASCII printable characters. This enables the default Windows terminal emulation program HyperTerminal to be used for configuring and testing modules. However this restriction and the restricted address range are not an official part of the protocol. Any of the 8 bit character values other than the framing characters can be used for the address and as any other part of the message.

3. Messages

Messages should be transmitted as a continuous character stream with less than a half character time between characters.

Messages are classified as either 'Commands' or 'Queries'. Commands instruct the designated Slave to do something. Queries request the designated Slave to provide information.
Apart from the leading '#' being replaced by a '*', the Slaves response to a Command should be an exact copy of the command message. In the case of a Query the query message is also echoed but the value or other requested information is added into the reply.

A one character time interval has to be allowed between outgoing and incoming messages, to allow for line turn-around (Switching between Transmit and Receive). At 57,600 baud, one character with 11 bits (one start, eight data, and two stop bits) transmits in 191 µS.

4. Validation

Commands are validated by comparing the content of the reply with the content of the command message on a character by character basis.

Queries are partially validated in a similar manner but the information added by the Slave is only subjected to credibility tests. When the information returned is deemed critical, repeating the Query and comparing results can further validate communications.

5. S Message Format

A two-character command/query designator follows the single address character. Depending on the nature of the command, the command designator may be followed by a numeric ASCII character string. No separator characters are used, but a carriage return character (0x0D) is inserted before the termination character in both the outgoing message and the reply.

6. Data Format

Data is transmitted at 57,600 Baud, with eight data bits, no parity, and two stop bits.

7. Recommended Interface Device

The RMS Technologies USB485 Converter Card converts the RS485 connection to a standard USB connection (1.1 and 2.0 compatible).

8. HyperTerminal Operation

In addition to setting the data format to match that specified in section 6, two settings must be made in the ASCII setup section. Check ‘Send Line Ends with Line Feeds’ and ‘Echo Typed Characters Locally’.

When typing by hand line turn-around will occur between characters. This is normally not a problem, but if you slowly increase the character transmission rate you will find errors occurring, until you reach a rate where the line is held in the transmit mode for the whole of the message. Using HyperTerminal’s file transfer system to send messages is not recommended.

9. Reading Reply Messages

The message read function on the RS232 side of the interface, must make provision for discarding any characters read that proceed the ‘*’ character. Line turn-around can commonly generate false characters.

The function should have a time-out associated with waiting for a reply to allow for a non-operational Slave node. The actual time required is system dependent, but 20mS is a commonly used value.

12. Troubleshooting

R325 is not functioning correctly

Try putting the R325 into TEST mode by placing a jumper on Pins 9 & 10 of JP2. The motor should twitch back and forth slightly if the R325 is functioning properly.

R325 not moving the motor (Step/Dip)

Verify that the 5V is being supplied to Pin 1.